AMERICAN CYANAMID COMPANY
WARNER'S PLANT
LINDEN, NEW JERSEY

PRELIMINARY REPORT OF TEST BORINGS AND DIKE EVALUATION AT THE WARNER'S PLANT IMPOUNDS

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1. INTRODUCTION

In June 1981, a preliminary report on the permeability of the alum sludge at the American Cyanamid Warner's Plant impounds was prepared by M. Disko Associates. The surface sludge field density ranged from 36 to 82 lbs/ft.^{3} and the permeability ranged from 1×10^{-4} to 8×10^{-6} cm/sec. Although the results indicated that the sludge is relatively impermeable, the New Jersey Department of Environmental Protection regulations consider 10^{-7} cm/sec as the requirement for an impermeable liner.

In September 1981, a preliminary report of soil borings and measurement of permeabilities of sludge and underlying soils was prepared by M. Disko Associates. Permeability tests were performed on samples of sludge taken at depths of 1 to 2 feet above the sludge/soil interface, and on samples of the underlying silt layer. The coefficients of permeability of the sludge samples at the bottom of the impounds range from 8×10^{-5} to 6×10^{-6} cm/sec, and the permeability coefficients for the subsurface silt samples range from 6×10^{-6} to 2×10^{-7} cm/sec.

Generally, the coefficients of permeability of the sludge at the bottom of the impounds were lower than the coefficients of permeability of the sludge at the upper sludge layers. However, the values obtained were still higher than the 10^{-7} cm/sec that the State regulations stipulate for an impermeable liner. Although the values for the silt layer are very close to the State requirements for an impervious liner, they do not fully satisfy the requirements.

? ... compaction material is becoming less permeable ?

Can we compress material ... make it OK? maybe more time will ...

In order to make further evaluations, it was proposed that core borings be taken through the dike areas to determine the type of soil material under the dikes, and to evaluate if the dikes were constructed on permeable or impermeable materials. The borings through the dike would be carried down through the silt layers to the Brunswick Formation to determine the depth to the aquifer. Determinations would be made of the permeability of the soil at selected depths in order to evaluate the level of vertical percolation.

As an additional part of this study, wells registered with the State of New Jersey within 2 miles of the impounds and Cyanamid's closed landfill would be located and tabulated with available information. A map of the Brunswick Formation aquifer would also be provided.

Core borings were taken and samples collected during the period October 21 to November 5, 1981. Eleven (11) borings were taken to a total of 284 feet.

2. TEST BORINGS

Eleven test borings were taken during the period October 21 to November 5, 1981 by P. J. Healey Company of Fanwood, New Jersey. The borehole locations are shown in Sheet 1 of 4 of the attached plans. The depths of the borings varied depending on the thickness of the fill material, the thickness of the sludge and underlying layers, and the depth to the Brunswick Shale.

Three of the test borings went into the Brunswick Shale. These were B-1, B-3, and B-4, with the shale encountered at depths of 38 feet, 38.5 feet and 29 feet respectively. Sludge was found in 8 of the 11 boreholes, indicating that the red clay, sand and gravel fill was placed on sludge in most cases.

A summary of the borings together with the depths of the dike fill material is given in Table 1.

In three of the boreholes, dike material was found to be directly on the meadow mat which is a surface layer of dead and decomposing reeds and grasses together with silt or clay. In a tidal marsh area, the meadow mat overlies a layer of gray organic silt. Generally, the organic mat extends from the surface to a depth varying from two feet to more than twelve feet. Highly organic sand, silt, clayey silt extend down to the underlying formation for variable depths.

TABLE 1

TEST BORING DATA

BOREHOLE DESIGNATION	TOTAL BOREHOLE DEPTH, FT.	RED CLAY, SAND & GRAVEL FILL DEPTH, FT.	REMARKS
B-1	38	13	Fill overlies 5 ft of sludge
B-2	33	33	No sludge or meadow mat encountered
B-3	39	19	Fill overlies 4 ft. of sludge
B-4	29	5	Fill overlies 5 ft. of sludge
B-5	29	10	6 ft. sludge overlies fill. Sludge also under the fill.
B-6	19	1.5	Sludge above and below fill
B-6A	21	9	5 ft. of sludge above & 7 ft. of sludge below fill
B-7	18	16	2 ft. of sludge at depth of 3 ft.
B-8	24	22	Fill lies on meadow mat
B-9	10	0	9.5 ft. of sludge lies on meadow mat
B-10	24	24	Fill lies on meadow mat
	284 L.F.		

From the three boreholes that extend to the shale, a picture emerges that is consistent with the soil types of a tidal marsh. The meadow mat is typically 4 to 6 feet thick and overlies a silt layer that is 7 to 9 feet thick. Underlying the silt layer are varying amounts of sand, clay and gravel that terminate at the Brunswick Shale.

In 7 of the boreholes dike fill material were found directly on top of sludge. The sludge layer varied from a thickness of 2 feet in B-7 to over 7 feet in B-6A. No fill material was found in B-9 and the fill material was sandwiched by sludges in B-5 and B-6. ? Why
Discovery of sludge under the dike in B-5 may suggest that the sludge covers a larger area than previously thought. > B 5 - inner edge

The test boring logs are shown in Sheet 2 of 4 of the attached plans.

The driller's logs are attached as Appendix 1.

3. PERMEABILITY TESTS

3.1 INTRODUCTION

Permeability tests were conducted on samples taken from the core boreholes. Samples were collected from 10 of the 11 boreholes. No samples were collected from B-9, since no dike fill material was found. Only sludge was encountered in B-9.

For each of the 10 boreholes that yielded samples, permeability tests were performed on samples from varying depths. The depths tested for the different boreholes are shown in Table 2.

3.2 DESCRIPTION OF PERMEABILITY TEST Valid Test Procedure?

The coefficient of permeability was calculated using the falling head test method on a boring sample. The boring sample is placed into a permeameter cylinder and subjected to a head of water. The head at the beginning of the test is recorded and then at a later time during the test the level of water in the pipette is measured again. The coefficient of permeability is calculated for each time test and then these values are combined to yield an average coefficient of permeability for the sample.

The formula used to calculate the falling head permeability was:

$$K = 2.3 \frac{aL}{AT} \log_{10}\frac{Ho}{H}$$

where:

K = coefficient of permeability, cm/sec

A = cross sectional area of permeameter, cm^2

L = length of specimen, cm

a = cross sectional area of standpipe (pipette), cm^2

T = time of test, sec.

H_o = head at start of test, cm

H = head at end of test, cm

It should be noted that the variables, A, L, and a are constant for each sample.

4.3 PERMEABILITY VALUES

The average coefficient of permeability for each sample tested is given in Table 2. Also given in Table 2 is the logged material type encountered at the depth at which the sample was taken.

The coefficients of permeability of the dike material tested ranged from 3×10^{-2} to 5×10^{-6} cm/sec. Although all the dike material was classified by the driller as clay, sand and gravel fill, the material varied from borehole to borehole. In order to put the coefficients of permeability into proper perspective, comparison can be made with the values listed below for various soil types.

Soil Type	Approximate Permeability Coefficient cm/sec
Gravel	10^{2} to 3×10^{-1}
Sand	3×10^{-1} to 10^{-3}
Very fine sands and silts, mixtures of sand with silt, mixtures of silt with clay	10^{-3} to 10^{-7}
Clay	10^{-7} or less

TABLE 2

COEFFICIENTS OF PERMEABILITY OF SAMPLES FROM TEST BORINGS AT AMERICAN CYANAMID WARNER'S PLANT IMPOUNDS

BOREHOLE DESIGNATION	SAMPLE DEPTH	COEFFICIENT OF PERMEABILITY CM/SEC	MATERIAL TYPE
B-1	13'-15'	3.53×10^{-5}	Sludge
	15'-18'	7.40×10^{-6}	Sludge
	18'-20'	1.46×10^{-5}	Organic Silt
	20'-23'	8.40×10^{-6}	Organic Silt
	29'-31'	7.68×10^{-4}	Sand & Gravel w/clay
	37'-38'	3.44×10^{-3}	Shale Fragments
B-2	8'-10'	2.82×10^{-4}	Clay, Sand & Gravel
	15'-18'	2.16×10^{-2}	Clay, Sand & Gravel
B-3	8'-10'	2.88×10^{-2}	Clay & Gravel
	13'-15'	6.65×10^{-3}	Clay & Gravel
	18'-20'	7.53×10^{-6}	Sludge
	20'-23'	1.17×10^{-5}	Sludge
	23'-25'	5.67×10^{-3}	Peat
	28'-31'	6.06×10^{-4}	Sand & Gravel w/clay
B-4	3'-5'	7.46×10^{-5}	Clay, Sand & Gravel
	9'-10'	7.41×10^{-6}	Sludge
	11'-13'	1.30×10^{-6}	Peat
	13'-16'	3.63×10^{-5}	Peat & Fine to Medium Sand
	16'-20'	3.79×10^{-4}	Fine to Med. Sand
	20'-23'	1.99×10^{-5}	Fine Sand & Silt
	25'-29'	4.31×10^{-6}	Clay, Sand & Gravel
B-5	10'-13'	8.94×10^{-6}	Clay, Sand & Gravel
	16'-19'	1.29×10^{-5}	Sludge
	21'-24'	2.80×10^{-6}	Sludge

TABLE 2, Cont'd.

COEFFICIENTS OF PERMEABILITY OF SAMPLES FROM TEST BORINGS AT AMERICAN CYANAMID WARNER'S PLANT IMPOUNDS

BOREHOLE DESIGNATION	SAMPLE DEPTH	COEFFICIENT OF PERMEABILITY CM/SEC	MATERIAL TYPE
B-6	10'-13'	6.19×10^{-5}	Sludge
B-6A	5'-8'	2.53×10^{-5}	Clay, Sand & Gravel
	13'-16'	3.68×10^{-6}	Sludge
	18'-21'	6.65×10^{-6}	Sludge
B-7	5'-8'	2.03×10^{-6}	Clay, Sand & Gravel
	13'-15'	7.63×10^{-3}	Clay, Sand & Gravel
	15'-18'	8.23×10^{-4}	Peat
B-8	5'-8'	3.81×10^{-3}	Clay, Sand & Gravel
	10'-13'	4.48×10^{-5}	Clay, Sand & Gravel
	15'-18'	1.06×10^{-5}	Clay, Sand & Gravel
	21'-24'	4.51×10^{-6}	Peat
B-10	10'-13'	1.83×10^{-4}	Clay, Sand & Gravel
	15'-18'	4.61×10^{-6}	Clay, Sand & Gravel
	21'-24'	7.88×10^{-6}	Clay, Sand & Gravel

On the basis of the permeability results, the dike material varied from fill containing mostly sand to a mixture of sand, silt and clay. It is also probable that the dike was not properly compacted when it was placed. It is obvious that the values obtained for the dikes cannot satisfy the State requirements of 10^{-7} cm/sec for an impermeable liner or cut-off wall.

The coefficients of permeability of the sludge samples tested ranged from 6×10^{-5} to 3×10^{-6} cm/sec, which is consistent with the values obtained from the two previous studies. In the previous studies the permeability ranged from 1×10^{-4} to 2×10^{-7} cm.

The dikes were placed directly on the meadow mat and organic silt that was found in the tidal marsh. The values of permeability of the underlying material ranged from 6×10^{-3} to 1×10^{-6} cm/sec. In some cases, the dikes were placed on the sludge. Generally, the values obtained for the coefficients of permeability do not satisfy the value of 10^{-7} cm/sec that the State regulations stipulate for an impermeable liner.

said that [illegible]
[illegible] - would have been [illegible] the dike sand/clay.

4. WELL DATA

There are 18 wells registered with the State of New Jersey that are located within a two mile radius of the edge of the impounds. Of these, 12 tap the Brunswick Shale aquifer and 6 are drilled into the Raritan Formation. Twenty-eight (28) wells that are registered with the State of New Jersey are located within 2 miles of Cyanamid's closed landfill in Linden. Eight (8) of these wells are within 2 miles of both sites. A list of the 38 wells that are within 2 miles of the impounds and/or the closed landfill is given in Table 3. Also shown in Table 3 are other available data for the wells including name of owner, location, year drilled, casing diameter, yield (if any), depth, screening depth, static level, pumping level, drawdown, depth to bedrock and the New Jersey Atlas Reference Number.

The locations of the wells are shown in Sheet 3 of 4 of the attached plans.

Of the 38 wells, only 14 have been drilled since 1960, and the more recent ones were drilled as monitoring wells. Is data public info? Fourteen of the wells were drilled in the 1941-1960 period and 6 were drilled prior to 1920. All excepting 6 of the wells were drilled into the Brunswick Formation. Twenty-seven of the wells are located in Linden, and 11 in Carteret. All 6 wells that tap the Raritan Formation are located in Carteret.

Although recent figures for water withdrawal from the Brunswick Formation are not readily available, it was reported that in 1966 some 6 to 7 million gallons per day of water was withdrawn by industry and public water supply companies from the Brunswick Shale in the Rahway area. The Brunswick Shale yields water from fracture openings and from pore spaces in the interbedded sandstone. Recharge to the Brunswick Formation occurs through the hydraulically continuous overlying glacial drift. Both water table and artesian conditions exist in the Brunswick Shale. Artesian conditions occur generally at depths greater than 100 feet. In 1966, the average yield of 150 industrial, public supply and domestic wells in the Rahway area was 75 gallons per minute, with an average specific capacity of 2.2 gpm per foot, and average well depth of 218 feet.

Groundwater from the Brunswick Shale is locally high in sulfate, dissolved solids, and hardness. This is due to solution of gypsum and calcite in the formation. Concentrations of these constituents increase with depth. Brackish water is contained in the Brunswick Shale along the tidal reach of the Rahway River and northward along the Arthur Kill.

A bedrock geologic map showing contours on the top of the Brunswick Shale is enclosed for reference.

TABLE 3

WELL DATA

WELL NO.	OWNER	LOCATION	YEAR DRILLED	CASING DIA. (IN.)	YIELD (GPM)	DEPTH (FT.)	SCREEN SETTING/ CASING DEPTH	STATIC LEVEL	PUMPING LEVEL/ HOURS PUMPED	DRAWDOWN (FT.)	DEPTH TO BEDROCK	N. J. ATLAS REF. NO.	REMARKS
	LINDEN												
1.	Vincent Pezzuto	108 W. Elm St.	1981	6	12	225	50	30	125/5	95	35	26-31-328	
2.	Solvents Recovery of N.Y.	120 Sylvan St.	1981	2	-	23	3	9	-/-	-	16.5	26-31-358	Monitorin Well
			1981	2	-	22.5	2.5	8	-/-	-	20	26-31-358	"
3.	Exxon	Bayway Refinery	1980	4	-	12	2	8	-/-	-	-	26-32-194	22 Monit. Wells
4.	Citgo	So. Wood Ave. Citgo Terminal	1981	26	-	20	20	-	-/-	-	-	26-32-194	Used for Recovery
5.	Standard Oil		1910	8	-	383	-	25	-/-	-	-	26-22-78	
	Standard Oil			-	-	1566	-	22	-/-	-	-	26-22-78	
6.	United Lacquer	100 Elizabeth Ave.	1947	8	100	500	-	-	-/-	-	-	26-31-319	
7.	Volupte, Inc.	Edgar & Dennis Sts.	1935	8	16	368	-	-	150/	-	-	26-22-749	
8.	Eastern Packing Co.	416 Linden Ave.	1950	8	100	400	-	11	138/	-	-	26-21-995	

TABLE 3, Cont'd.

WELL DATA

WELL NO.	OWNER	LOCATION	YEAR DRILLED	CASING DIA. (IN.)	YIELD (GPM)	DEPTH (FT.)	SCREEN SETTING/ CASING DEPTH	STATIC LEVEL	PUMPING LEVEL/ HOURS PUMPED	DRAWDOWN (FT.)	DEPTH TO BEDROCK	N. J. ATLAS REF. NO.	REMARKS
	LINDEN, Cont'd.												
9.	Linden Milk Co.		1922	-	50	140	-	26	-/-	-	-	26-31-339	
10.	Park Plastic Co.	940 Park Ave.	1950	6	60	255	32	7	65/6	-	-	26-22-772	
11.	Morton Sand	Rt. 25	1949	8/6	8	155	23	45	88/2	-	-	26-21-983	
12.	Rosehill Cem.		1909	-	15	209	-	15	17/	-	-	26-21-997	
13.	Pacific Airmotive Corp.	Linden Airport	1950	8	80	300	31	5	-/-	100	-	26-31-355	
14.	Pa. RR Station		1903	-	21	122	-	-	-/-	-	-		
15.	W. Melanchuk	828 Smith St.	1952	6	5	96	40	12	-/-	-	-	25-31-343	
16.	Linden Cem. Assoc.	near RR	1912	-	21	71	-	-	-/-	-	-	26-21-997	
17.	Hollywood Dr.In	Edgar Rd.	1950	8	20	170	30	19	25/	-	-	26-31-332	

TABLE 3, Cont'd.

WELL DATA

WELL NO.	OWNER	LOCATION	YEAR DRILLED	CASING DIA. (IN.)	YIELD (GPM)	DEPTH (FT.)	SCREEN SETTING/ CASING DEPTH	STATIC LEVEL	PUMPING LEVEL/ HOURS PUMPED	DRAWDOWN (FT.)	DEPTH TO BEDROCK	N. J. ATLAS REF. NO.	REMARKS
	LINDEN, Cont'd.												
18.	Automotive Prod. Credit Assn.		1957	6	31	245	160' 9"	23	31/8	8	-	26-31-332	
19.	Linden Ice Co.	18 Donaldson Pl.	1959	8	70	550	40	19	110/8	91	30		
20.	Apex Rendezvous	1135 W. Eliz. Ave.	1972	6	90	440	30	25	250/5	225	-	26-31-328	
21.	Layne N.Y.	1250 W. Eliz. Ave.	1955	12	30	306	36	20	120/6	100	-	26-31-342	
22.	Smith Kessler	1414 E. Linden Ave.	1965	8	65	360	27	8	150/8	142	65	26-31-372	
23.	Dog Pound	Range Rd.	1972	10/6	20	460	54	7	300/7	293	-	26-31-388	
24.	Newark Steel Barrel & Drum Co.	Blancke Ave. So. of Stiles	1930	6	9	247	-	18	75/	-	51		
			1930	10	15	39	-	8	-/-	-	-		
			1927	-	16	-	-	14	120/	-	-		
			1937	-	50	208	-	15	33/	-	40		
25.	Airline Foods	1130 W. Eliz. Ave.	1949	8	25	266	42	25	173/5	148	37		

TABLE 3, Cont'd.

WELL DATA

WELL NO.	OWNER	LOCATION	YEAR DRILLED	CASING DIA. (IN.)	YIELD (GPM)	DEPTH (FT.)	SCREEN SETTING/ CASING DEPTH	STATIC LEVEL	PUMPING LEVEL/ HOURS PUMPED	DRAWDOWN (FT.)	DEPTH TO BEDROCK	N. J. ATLAS REF. NO.	REMARKS
	LINDEN, Cont'd.												
26.	Distillers Co. Ltd.		1934	12	65	316	33	4.5	123/8	115.5	33	-	
			1934	12	23	306	-	2.5	122/8	120.5	35	-	
27.	C H & John Winans	Wood Ave. & 14th St.	1903	6	750	200	-	-	-/-	-	16	-	
			1903	6	750	146	-	-	-/-	-	-	-	
	CARTERET												
28.	Exxon	Roosevelt Ave.	1981	4	-	25	5	10	-/-	-	18	26-31-639	For Monitoring
29.	Roselle Plastic Corp.	51 Lafayette St.	1959	6	60	136	76	30	95/8	65	40	26-32-455	Raritan Formation
30.	Vanguard	Roosevelt Blvd. & Lafayette St.	1969	6	15	300	63	12	250/4	238	60'	26-32-451	60' Argilite
31.	Gulf Stream Dev.		1967	8	100	145	54	20	105/5	85	40'	26-32-417	40' Diabase
32.	Wilgreen Ind.	500 Milik St.	1967	8	100	300	50	12	-/-	-	45	26-31-628	
33.	Metro Glass	Minue St.	1963	8	120	200	42	15	52/8	32	-	26-31-637	

TABLE 3, Cont'd.

WELL DATA

WELL NO.	OWNER	LOCATION	YEAR DRILLED	CASING DIA. (IN.)	YIELD (GPM)	DEPTH (FT.)	SCREEN SETTING/ CASING DEPTH	STATIC LEVEL	PUMPING LEVEL/ HOURS PUMPED	DRAWDOWN (FT.)	DEPTH TO BEDROCK	N. J. ATLAS REF. NO.	REMARK
	CARTERET, Cont'd.												
34.	Edward Ogarek	Minue Rd.	1965	6	40	100	52	20	40/2	20	-	26-31-637	
35.	Kagon & Dixon Co.	Blair Rd.	1969	8	55	440	49	20	250/8	230	-	26-31-651	
36.	United States Metals & Ref. Co.		1954	-	55	42	-	10	-/-	-	-	26-32-479	Raritan Formation
			1954	-	50	40	-	15	-/-	-	-	-	"
37.	Amer. Agricultural Chemical Co.		1942	-	20	65	-	6	-/-	-	65	26-32-482	Raritan Formation
38.	Chrome Steel Co.		1906	-	6	58	-	10	-/-	-	90	26-32-484	Raritan Formation

5. EVALUATION AND ANALYSIS

The borings indicate that the dikes do not extend below the original ground line, but were built on top of the meadow mat. There are no indications of clay cut-off walls, in fact there is very little evidence of low permeability material being used for the construction of the dikes.

The meadow mat is more permeable than the silt subsurface with the coefficient of permeability ranging from 6×10^{-3} to 1×10^{-6} cm/sec. This can result in lateral movement of leachate into the surrounding rivers and streams. This lateral movement should be confined within the impound area by impervious cut-off walls. Since the investigation did not indicate the presence of any cut-off walls, consideration should be given to the construction of these impervious cut-off walls to confine leachate within the impound area.

Another area of concern is the effectiveness of the dikes. In areas that offer evidence of dikes, the dikes were placed on the original ground. However, the material used for the construction of the dikes afford very little barrier to the movement of leachate. The coefficient of permeability of the dike material ranges from 3×10^{-2} to 5×10^{-6} cm/sec. These values are significantly higher than the State stipulated 10^{-7} cm/sec for impermeable liner. With the key concerns of the Federal and State regulatory agencies being the protection of local surface and groundwater, the existing dikes cannot be offered as the means of confining leachate to the impound areas.

The borings indicate that in some areas there are no dike material present. In other areas, dikes were placed on top of the sludge. In seven of the eleven boreholes, dike fill material were found directly on top of sludge. In one borehole, no fill material was found, and in two boreholes fill material was sandwiched by sludge. Discovery of sludge under the dike in B-5, between Impound No. 5 and the Rahway River, may suggest that the sludge covers a larger area than indicated in the plans. Hand probings along the northern boundary of Impound No. 3 opposite Second Island, did not encounter any evidence of dikes. The probings indicated that sludge was placed directly on the meadow mat. Hand probings also indicated that no dike exists along the southern boundary of Impound No. 2.

Borings indicate that the depth to bedrock from the bottom of the sludge layer varies from 16 to 20 feet. The sludge overlies a layer of meadow mat 4 to 6 feet thick, which is underlaid by the organic silt layer 7 to 9 feet thick. Between the silt and bedrock is a layer of varying amounts of sand, clay and gravel.

The depth to bedrock is consistent with the values obtained during test borings at the closed American Cyanamid landfill. Previous studies indicated that the coefficient of permeability in the silt layer ranges from 6×10^{-6} to 2×10^{-7} cm/sec. Movement of water through the silt layer would therefore be very slow. However, the coefficient of the sand, clay and gravel layer that overlies the Brunswick Shale varies from 3×10^{-3} to 4×10^{-6} cm/sec, which indicates a more rapid movement of water within this layer. This layer conforms to the glacial drift of the Wisconsin and consists of reddish-brown clay, sand and gravel, unstratified and unsorted. This layer and the Brunswick Shale are hydraulically continuous in most areas, and infiltrated precipitation percolates directly through the glacial drift and into the fracture openings of the shale.

The coefficients of permeability of the sludge samples tested ranged from 6×10^{-5} to 3×10^{-6} cm/sec, which is consistent with values obtained from the two previous studies. In most cases, the water table was found to be at the surface of the sludge layer. When a hydrostatic head is applied to the water in the sludge layer, it is believed that the water containing possible pollutants could definitely percolate into the Brunswick Shale. Most of the restraint to movement of groundwater is provided by the bottom silt layer of soil. However, even this slow rate of movement would not stop infiltration into the Brunswick Shale. The only possibility of stopping or limiting infiltration into the Brunswick Shale aquifer is by capping the impounds.

It should be noted that while efforts are being made to determine methods of preventing possible contamination of neighboring ground and surface waters, there is evidence of liquid draining from the impounds into the Rahway River. While locating test hole B-8, one of our engineers noticed a wooden box culvert in the back of the dike between Impound #6 and the Rahway River. Blue and green liquid was draining from the culvert into the River. It was observed that the plants and soils in the immediate vicinity of the culvert were stained by the liquid draining from the impound. Localized impact on the Rahway River was also observed. The approximate location of the box culvert is shown in Sheet 1 of 4 of the accompanying plans. Steps should be taken immediately to stop the flow of liquid into the River, and efforts should be directed towards the location of other possible drains. Problems can develop if the spills are noticed and the Coast Guard is called in to investigate. Other State and Federal agencies, including the N.J. DEP and the U.S. EPA, also have jurisdiction over <u>spills</u> into surface waters.

Is this really a spill? need a definition defined?

There are eighteen (18) wells registered with the State of New Jersey that are located within a two mile radius of the boundaries of the six impounds. Twelve (12) of these wells were drilled into the Brunswick Shale aquifer and six (6) tap the Raritan Formation aquifer. Of the eighteen wells, 3 were drilled before 1910, 4 between 1920 and 1960, 6 in the 1960's, and 5 since 1970. Of the newer wells, the 3 sets drilled in 1980 to 1981 are used exclusively for monitoring purposes. Four (4) of the wells drilled since 1954 tap the Raritan Formation.

There are only five (5) registered wells within a one mile radius of the impounds. Of these, only two (2) are in the Brunswick Shale, and these were drilled by Exxon and Citgo for monitoring purposes. The other three (3) were drilled into the Raritan Formation. The aquifers of the Raritan Formation are separated hydraulically from the Brunswick Shale by the basal Raritan fine clay.

The literature indicates that the groundwater from the Brunswick Shale is locally high in sulfate, dissolved solids, and hardness due to solution of gypsum and calcite in the formation. It is also possible that the Brunswick Formation under the impounds contains brackish water due to salt water intrusion from the tidal Rahway River.

It is possible, therefore, to minimize and contain infiltration into the Brunswick Shale by capping the impounds.

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the three studies conducted by M. Disko Associates at the sludge impounds can be summarized as follows:

1. There will be slow movement of water within the sludge based on the measured coefficients of permeability. Any downward vertical movement of water would result in leachate percolating into the underlying meadow mat and silt layers and eventually into the Brunswick Shale.
2. The measured coefficients of permeability of the underlying silt layer indicate that the movement of water within this layer would be extremely slow. However, the permeability does not satisfy the State requirement for impervious liners.
3. The borings indicate that the dikes are very ineffective in the prevention of lateral movement of leachate out of the impounds. The permeability of the dike material is far above the State requirements, and would not act as a barrier to leachate movement.
4. The dikes do not extend below the original ground line, but were built on top of the meadow mat. There is no evidence of clay cut-off walls, or any other type of cut-off walls. Even though the silt layer would afford some resistance to movement of water, the water could move laterally in the meadow mat and leave the impound area. This can lead to possible contamination of the surface and groundwaters in the area.

In view of the above, it is recommended that consideration should be given to the capping of the top and sides of the lagoons. This "sealing" of the impounds would prevent rainfall from constantly percolating into the impounds and causing a hydraulic head to force leachate into the meadow mat both vertically and laterally. The meadow mat must be blocked using cut-off walls to prevent lateral flow of leachate.

Capping of the impounds can be done by placing a 12" layer of impermeable clay having a coefficient of permeability of less than 10^{-7} cm/sec over the top and sides of the impounds, totally enclosing the sludge materials and the dikes. The cap will prevent water from constantly entering the sludge deposits thereby reducing the long-term potential of leachate contamination of the Brunswick Shale aquifer. In addition, soil would be necessary to provide a base for vegetation in order to stabilize the "cap" from erosion. The clay cover should be tied into a clay cut-off blanket that would surround the impound area. This clay cut-off blanket would prevent lateral flow of leachate from the impounds.

The entire area of the clay cap would have to be sloped to drain with a minimum of 1% slope. To prevent soil erosion, the clay layer should be covered with a layer of topsoil that could promote the growth of grass. The total cap cover might be 2 feet or somewhat more.

The design of an impound stabilization plan utilizing the concept of capping and cut-off blankets can only be done after a topographic survey of the area is available. When a survey is completed, a preliminary design can provide the quantity of clay that would be needed, the depth of the cut-off trenches, and the slope to be provided for drainage. From a preliminary design, a preliminary cost estimate can be obtained.

APPENDIX 1

PHILIP J. HEALEY COMPANY est. 1870
43 SOUTH AVENUE, FANWOOD, NEW JERSEY 07023 (201) 322-6500

TEST BORING DATA

Project: American Cyanamid — TEST HOLE NO. 1
Location: Carteret, New Jersey — Sheet 1 of 1
Boring Contractor: Philip J. Healey Company — Surface Elevation:
Inspector: — Ground water observations
Date Started: 10/21/81 — Depth: 13.0' — Date: 10/21/81
Date Completed: 10/21/81 — Depth: — Date:

Depth in Feet	Casing Blows	Sample No.	Depth From	Depth To	Blows on Spoon 0-6	6-12	12-18	18-24	Rec.	Sample Identification and Profile Change	Elev.
		S-1	3.0	5.0	5	10	10	11		Red Clay, Sand & Gravel	
5											
		S-2	8.0	10.0	15	11	7	7			
10											13.0'
		S-3	13.0	15.0	8	9	12	15		Blk. SLUDGE	
15		S-4	15.0	18.0	8	10	13	11			
					8	8					18.0
		S-5	18.0	20.0	3	4	4	5		Blk. Organic with Peat	
20		S-6	20.0	23.0	8	6	7	7			
					7	7					22.0'
		S-7	23.0	25.0	8	6	6	6		Blk.-Grey Organic	25.0'
25		S-8	25.0	28.0	6	6	7	8		Blk. Organic, s. Peat	
					10	11					
		S-9	28.0	30.0	7	9	21	49			29.0'
30		S-10	30.0	33.0	20	20	10	15		Red Sand & Gravel, t. Clay	31.0'
					18	26					
		S-11	33.0	35.0	29	28	31	36		Red Clay, Gravel, t. Sand	
35		S-12	35.0	38.0	26	26	42	43			
					40	112					37.5'
										Shale Fragments	38.0'
40										Refusal	

I. D. Casing	in	Wgt. Hammer on Casing	lb
I. D. Spoon	1-3/8 in	Wgt. Hammer on Spoon	140 lb
Type Core Drill		Drop Hammer on Casing	in
Core Dia.	in	Drop Hammer on Spoon	30 in

Symbol	a.	s.	l.	t.
Proportions	and	some	little	trace
% By Wgt.	35 to 50	20 to 35	10 to 20	1 to 10

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TEST BORING DATA

Project:	American Cyanamid	TEST HOLE NO.	2
Location:	Carteret, New Jersey	Sheet 1	of 1
Boring Contractor:	Philip J. Healey Company	Surface Elevation:	
Inspector:		Ground water observations	
Date Started:	10/22/81	Depth:	Date: 10/22/81
Date Completed:	10/22/81	Depth:	Date:

Depth Feet	Casing Blows	Sample No.	Depth From	Depth To	Blows on Spoon 0-6	6-12	12-18	18-24	REC.	SAMPLE IDENTIFICATION AND PROFILE CHANGE	ELEV.
		S-1	3.0	5.0	6	8	10	14		Red Clay, Brn. Sand, Gravel, misc. fill	
5											
		S-2	8.0	10.0	18	24	25	40			
10										No samples or blow counts on spoon needed by inspector.	
15											
20											
25											
30											33.0'
35										End of Boring	
40											

I. D. Casing	in	Wgt. Hammer on Casing	lb	Symbol	a.	s.	l.	t.
I. D. Spoon	1-3/8 in	Wgt. Hammer on Spoon	140 lb	Proportions	and	some	little	trace
Type Core Drill		Drop Hammer on Casing	in	% By Wgt.	35 to 50	20 to 35	10 to 20	1 to 10
Core Dia.	in	Drop Hammer on Spoon	30 in					

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43 SOUTH AVENUE, FANWOOD, NEW JERSEY 07023 (201) 322-6500

TEST BORING DATA

Project: American Cyanamid — TEST HOLE NO. 3

Location: Carteret, New Jersey — Sheet 1 of 1

Boring Contractor: Philip J. Healey Company — Surface Elevation:

Inspector: — Ground water observations

Date Started: 10/22/81 — Depth: 19.0' — Date: 10/22/81

Date Completed: 10/22/81 — Depth: — Date:

Depth... Feet	Casing Blows	Sample No.	Depth		Blows on Spoon 0-6	6-12	12-18	18-24	Rec.	Sample Identification and Profile Change	Elev.
		S-1	3.0	5.0	23	22	18	16		Red Clay and Gravel Fill	
5											
		S-2	8.0	10.0	26	18	22	16			
10											
		S-3	13.0	15.0	42	31	42	33			
15											
		S-4	15.0	18.0	25	19	21	25			
					33	33					
		S-5	18.0	20.0	34	30	19	19			19.0'
20											
		S-6	20.0	23.0	6	4	5	5		Sludge	
					4	5					23.0'
		S-7	23.0	25.0	8	10	10	11			
25											
		S-8	25.0	28.0	10	10	14	15		Peat	
					21	19					
		S-9	28.0	31.0	18	19	22	41			
30					52	57					29.5'
										Red Sand and Gravel, s. Clay	
35											
		S-10	38.0	39.0		125					39.0'
40										Refusal	

I. D. Casing	in	Wgt. Hammer on Casing	lb	Symbol	a.	s.	l.	t.
I. D. Spoon	1-3/8 in	Wgt. Hammer on Spoon	140 lb	Proportions	and	some	little	trace
Type Core Drill		Drop Hammer on Casing	in	% By Wgt.	35 to 50	20 to 35	10 to 20	1 to 10
Core Dia.	in	Drop Hammer on Spoon	30 in					

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TEST BORING DATA

Project:	American Cyanamid	TEST HOLE NO.	4
Location:	Carteret, New Jersey	Sheet 1	of 1
Boring Contractor:	Philip J. Healey Company	Surface Elevation:	
Inspector:		Ground water observations	
Date Started:	10/30/81	Depth: 8.0'	Date: 10/30/81
Date Completed:	10/30/81	Depth:	Date:

Depth in Feet	Casing Blows	Sample No.	Depth		Blows on Spoon 0–6	6–12	12–18	18–24	Rec.	Sample Identification and Profile Change	Elev.
										Red Clay, Sand & Gravel fill	
		S-1	3.0	5.0	28	30	52	32			
5											5.0'
		S-2	5.0	8.0	9	6	3	5			
					5	4				Sludge	
											8.0'
		S-3	8.0	11.0	2	3	3	3			
10					3	4					10.0'
		S-4	11.0	13.0	2	3	3	4			
										Peat	
		S-5	13.0	16.0	5	5	5	12			
15					22	33					14.5'
		S-6	16.0	18.0	15	18	22	24		Grey fine to med.Sand	
		S-7	18.0	20.0	30	22	22	26			19.0'
20											
		S-8	20.0	23.0	18	15	12	12		Red f Sand & Silt	
					13	15					
		S-9	23.0	25.0	15	22	25	26			23.5'
25											
										Red Clay, Sand, Gravel	
										No Penetration	29.0'
30										Refusal	
35											
40											

I. D. Casing	in	Wgt. Hammer on Casing	lb	Symbol	a.	s.	l.	t.
I. D. Spoon 1-3/8	in	Wgt. Hammer on Spoon 140	lb	Proportions	and	some	little	trace
Type Core Drill		Drop Hammer on Casing	in	% By Wgt.	35 to 50	20 to 35	10 to 20	1 to 10
Core Dia.	in	Drop Hammer on Spoon 30	in					

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TEST BORING DATA

Project:	American Cyanamid	TEST HOLE NO.	5
Location:	Carteret, New Jersey	Sheet 1 of 1	
Boring Contractor:	Philip J. Healey Company	Surface Elevation:	
Inspector:		Ground water observations	
Date Started:	11/3/81	Depth:	Date: 11/3/81
Date Completed:	11/3/81	Depth:	Date:

Depth ... Feet	Casing Blows	Sample No. Depth			Blows on Spoon 0–6	6–12	12–18	18–24	REC.	Sample Identification and Profile Change	ELEV.
										Sludge	
5											6.0'
										Red Clay, Sand & Gravel No samples required or blow count	
10											
15											16.0'
20										Sludge	
25											29.0'
30										End of Boring	
35											
40											

I. D. Casing	in	Wgt. Hammer on Casing	lb	Symbol	a.	s.	l.	t.
I. D. Spoon	1-3/8 in	Wgt. Hammer on Spoon	140 lb	Proportions	and	some	little	trace
Type Core Drill		Drop Hammer on Casing	in	% By Wgt.	35 to 50	20 to 35	10 to 20	1 to 10
Core Dia.	in	Drop Hammer on Spoon	30 in					

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TEST BORING DATA

Project: American Cyanamic — TEST HOLE NO. 6
Location: Carteret, New Jersey — Sheet 1 of 1
Boring Contractor: Philip J. Healey Company — Surface Elevation:
Inspector: — Ground water observations
Date Started: 11/4/81 — Depth: — Date: 11/4/81
Date Completed: 11/4/81 — Depth: — Date:

Depth in Feet	Casing Blows	Sample No.	Depth		Blows on Spoon 0/6	6/12	12/18	18/24	REC.	Sample Identification and Profile Change	ELEV.
5										Sludge	
10											
		S-1	10.0	13.0	3	4	6	6			
					5	8	10	10			
		S-2	13.0	14.0							12.5'
										Red Clay, Sand, Gravel	14.0'
15		S-3	14.0	16.0	2	4	7	9			
		S-4	16.0	19.0	2	4	4	5		Sludge	
					5	5				Peat at 19.0'	
											19.0'
20										End of Boring	
25											
30											
35											
40											

I. D. Casing	in	Wgt. Hammer on Casing	lb	Symbol	a.	s.	l.	t.
I. D. Spoon	1-3/8 in	Wgt. Hammer on Spoon	140 lb	Proportions	and	some	little	trace
Type Core Drill		Drop Hammer on Casing	in	% By Wgt.	35 to 50	20 to 35	10 to 20	1 to 10
Core Dia.	in	Drop Hammer on Spoon	30 in					

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TEST BORING DATA

Project:	American Cyanamid	TEST HOLE NO.	6A
Location:	Carteret, New Jersey	Sheet	1 of 1
Boring Contractor:	Philip J. Healey Company	Surface Elevation:	
Inspector:		Ground water observations	
Date Started:	11/4/81	Depth:	Date: 11/4/81
Date Completed:	11/4/81	Depth:	Date:

Depth in Feet	Casing Blows	Sample No.	Depth		Blows on Spoon 0/6	6/12	12/18	18/24	REC.	Sample Identification and Profile Change	ELEV.
										Sludge	
5											5.0'
		S-1	5.0	8.0						Red Clay, Sand, Gravel	
10										No blow count required.	
		S-2	13.0	16.0							14.0'
15											
										Sludge	
		S-3	18.0	21.0							
20										No blow count required	
											21.0'
										End of Boring	
25											
30											
35											
40											

I. D. Casing	in	Wgt. Hammer on Casing	lb	Symbol	a.	s.	l.	t.
I. D. Spoon	1-3/8 in	Wgt. Hammer on Spoon	140 lb	Proportions	and	some	little	trace
Type Core Drill		Drop Hammer on Casing	in	% By Wgt.	35 to 50	20 to 35	10 to 20	1 to 10
Core Dia.	in	Drop Hammer on Spoon	30 in					

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TEST BORING DATA

Project:	American Cyanamid	TEST HOLE NO.	7
Location:	Carteret, New Jersey	Sheet 1 of 1	
Boring Contractor:	Philip J. Healey Company	Surface Elevation:	
Inspector:		Ground water observations	
Date Started:	11/4/81	Depth:	Date: 11/4/81
Date Completed:	11/4/81	Depth:	Date:

Depth in Feet	Casing Blows	Sample No.	Depth		Blows on Spoon 0–6	6–12	12–18	18–24	REC.	Sample Identification and Profile Change	ELEV.
										Red Clay, Sand & Gravel	3.0'
5										Sludge	5.0'
		S-1	5.0	8.0						Red Clay, Sand & Gravel	
10											
										No blow count required.	
15											16.0'
		S-2	16.0	18.0						Peat	18.0'
20										End of Boring	
25											
30											
35											
40											

I. D. Casing in	Wgt. Hammer on Casing lb	Symbol		a.	s.	l.	t.
I. D. Spoon 1-3/8 in	Wgt. Hammer on Spoon 140 lb	Proportions		and	some	little	trace
Type Core Drill	Drop Hammer on Casing in	% By Wgt.		35 to 50	20 to 35	10 to 20	1 to 10
Core Dia. in	Drop Hammer on Spoon 30 in						

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TEST BORING DATA

Project:	American Cyanamid	TEST HOLE NO.	8
Location:	Carteret, New Jersey	Sheet 1	of 1
Boring Contractor:	Philip J. Healey Company	Surface Elevation:	
Inspector:		Ground water observations	
Date Started:	11/5/81	Depth:	Date: 11/5/81
Date Completed:	11/5/81	Depth:	Date:

Depth Feet	Casing Blows	Sample No.	Depth (from)	Depth (to)	Blows on Spoon 0–6	6–12	12–18	18–24	REC.	Sample Identification and Profile Change	ELEV.
										Red Clay, Sand, Gravel	
5		S-1	5.0	8.0							
10		S-2	10.0	13.0						No blow count required.	
15		S-3	15.0	18.0							
20											22.0'
		S-4	22.0	24.0						Peat	24.0'
25										End of Boring	
30											
35											
40											

I. D. Casing		in	Wgt. Hammer on Casing		lb	Symbol	a.	s.	l.	t.
I. D. Spoon	1-3/8	in	Wgt. Hammer on Spoon	140	lb	Proportions	and	some	little	trace
Type Core Drill			Drop Hammer on Casing		in	% By Wgt.	35 to 50	20 to 35	10 to 20	1 to 10
Core Dia.		in	Drop Hammer on Spoon	30	in					

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TEST BORING DATA

Project:	American Cyanamid	TEST HOLE NO.	9
Location:	Carteret, New Jersey	Sheet 1	of 1
Boring Contractor:	Philip J. Healey Company	Surface Elevation:	
Inspector:		Ground water observations	
Date Started:	11/5/81	Depth:	Date: 11/5/81
Date Completed:	11/5/81	Depth:	Date:

Depth in Feet	Casing Blows	SAMPLE NO. DEPTH			BLOWS ON SPOON 0/6	6/12	12/18	18/24	REC.	SAMPLE IDENTIFICATION AND PROFILE CHANGE	ELEV.
5										Sludge Peat at 9.5' No samples or blow counts required.	
10											10.0'
										End of Boring	
15											
20											
25											
30											
35											
40											

I. D. Casing	in	Wgt. Hammer on Casing	lb	Symbol	a.	s.	l.	t.
I. D. Spoon	1-3/8 in	Wgt. Hammer on Spoon	140 lb	Proportions	and	some	little	trace
Type Core Drill		Drop Hammer on Casing	in	% By Wgt.	35 to 50	20 to 35	10 to 20	1 to 10
Core Dia.	in	Drop Hammer on Spoon	30 in					

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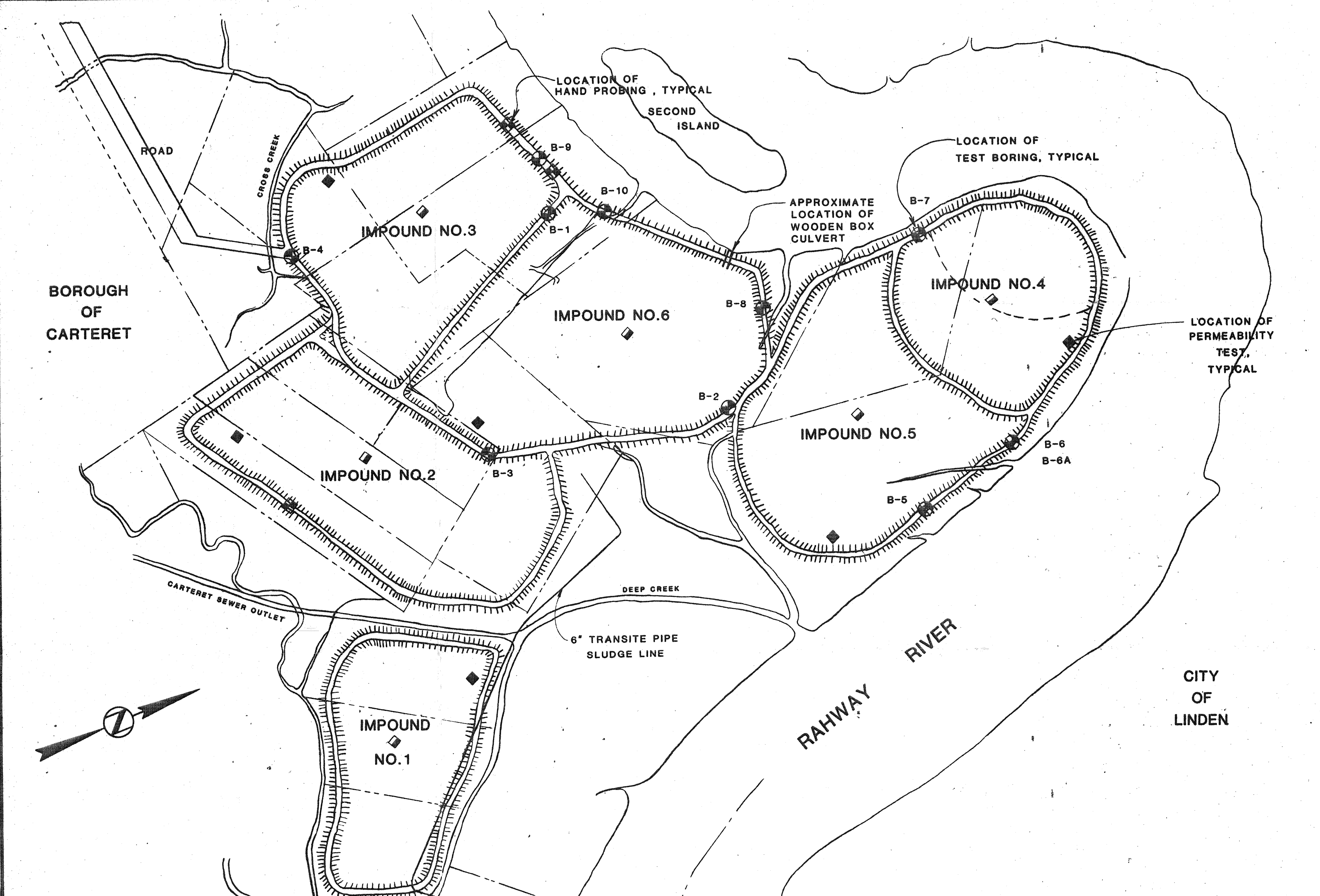
TEST BORING DATA

Project:	American Cyanamid	TEST HOLE NO.	10
Location:	Carteret, New Jersey	Sheet 1 of 1	
Boring Contractor:	Philip J. Healey Company	Surface Elevation:	
Inspector:		Ground water observations	
Date Started:	11/5/81	Depth:	Date: 11/5/81
Date Completed:	11/5/81	Depth:	Date:

Depth in Feet	Casing Blows	Sample No.	Depth		Blows on Spoon 0–6	6–12	12–18	18–24	REC.	Sample Identification and Profile Change	ELEV.
										Red Clay,Sand, Gravel	
5											
10		S-1	10.0	13.0						No blow count required.	
15		S-2	15.0	18.0							
20		S-3	20.0	23.0							
											24.0'
25										End of Boring	
30											
35											
40											

I. D. Casing	in	Wgt. Hammer on Casing	lb	Symbol	a.	s.	l.	t.
I. D. Spoon 1-3/8	in	Wgt. Hammer on Spoon 140	lb	Proportions	and	some	little	trace
Type Core Drill		Drop Hammer on Casing	in	% By Wgt.	35 to 50	20 to 35	10 to 20	1 to 10
Core Dia.	in	Drop Hammer on Spoon 30	in					



JUNE 1981 STUDY		
LOCATION	TOP SLUDGE LAYER	
	FIELD DENSITY LBS./CU.FT.	PERMEABILITY CM./SEC.
IMPOUND #1		
EDGE	59.90	1.19×10^{-4}
CENTER	51.51	6.67×10^{-6}
IMPOUND #2		
EDGE	36.42	5.61×10^{-5}
CENTER	46.75	6.05×10^{-5}
IMPOUND #3		
EDGE	81.88	4.02×10^{-5}
CENTER	81.32	2.63×10^{-5}
IMPOUND #4		
EDGE	51.96	1.03×10^{-4}
CENTER	48.92	5.73×10^{-5}
IMPOUND #5		
EDGE	39.70	8.06×10^{-6}
CENTER	50.60	2.28×10^{-5}
IMPOUND #6		
EDGE	66.47	1.34×10^{-5}
CENTER	42.31	1.62×10^{-5}

SEPTEMBER 1981 STUDY		
LOCATION	PERMEABILITY CM./SEC.	
	BOTTOM SLUDGE LAYER	UNDERLYING SOIL
IMPOUND #1		
EDGE	1.49×10^{-5}	1.07×10^{-6}
CENTER	3.65×10^{-5}	2.43×10^{-6}
IMPOUND #2		
EDGE	1.67×10^{-5}	3.00×10^{-6}
CENTER	1.05×10^{-5}	2.20×10^{-7}
IMPOUND #3		
EDGE	2.58×10^{-5}	1.63×10^{-6}
CENTER	5.90×10^{-6}	1.44×10^{-6}
IMPOUND #4		
EDGE	8.07×10^{-6}	6.34×10^{-6}
CENTER	3.06×10^{-5}	4.87×10^{-6}
IMPOUND #5		
EDGE	8.00×10^{-5}	3.87×10^{-6}
CENTER	3.09×10^{-5}	2.40×10^{-7}
IMPOUND #6		
EDGE	9.15×10^{-6}	4.12×10^{-6}
CENTER	2.67×10^{-5}	3.25×10^{-7}

JANUARY 1982 STUDY			
LOCATION	TOTAL BOREHOLE DEPTH, FT.	TOTAL DIKE MATERIAL DEPTH, FT.	REMARKS
B-1	38	13	FILL OVERLIES 5 FT. SLUDGE
B-2	33	33	NO SLUDGE OR MEADOW MAT ENCOUNTERED
B-3	39	19	FILL OVERLIES 4 FT. SLUDGE
B-4	29	5	FILL OVERLIES 5 FT. SLUDGE
B-5	29	10	SLUDGE ABOVE AND BELOW FILL
B-6	19	1.5	SLUDGE ABOVE AND BELOW FILL
B-6A	21	9	SLUDGE ABOVE AND BELOW FILL
B-7	18	16	FILL ABOVE AND BELOW SLUDGE
B-8	24	22	FILL LIES ON MEADOW MAT
B-9	10	0	NO FILL. SLUDGE LIES ON MEADOW MAT
B-10	24	24	FILL LIES ON MEADOW MAT

NOTES

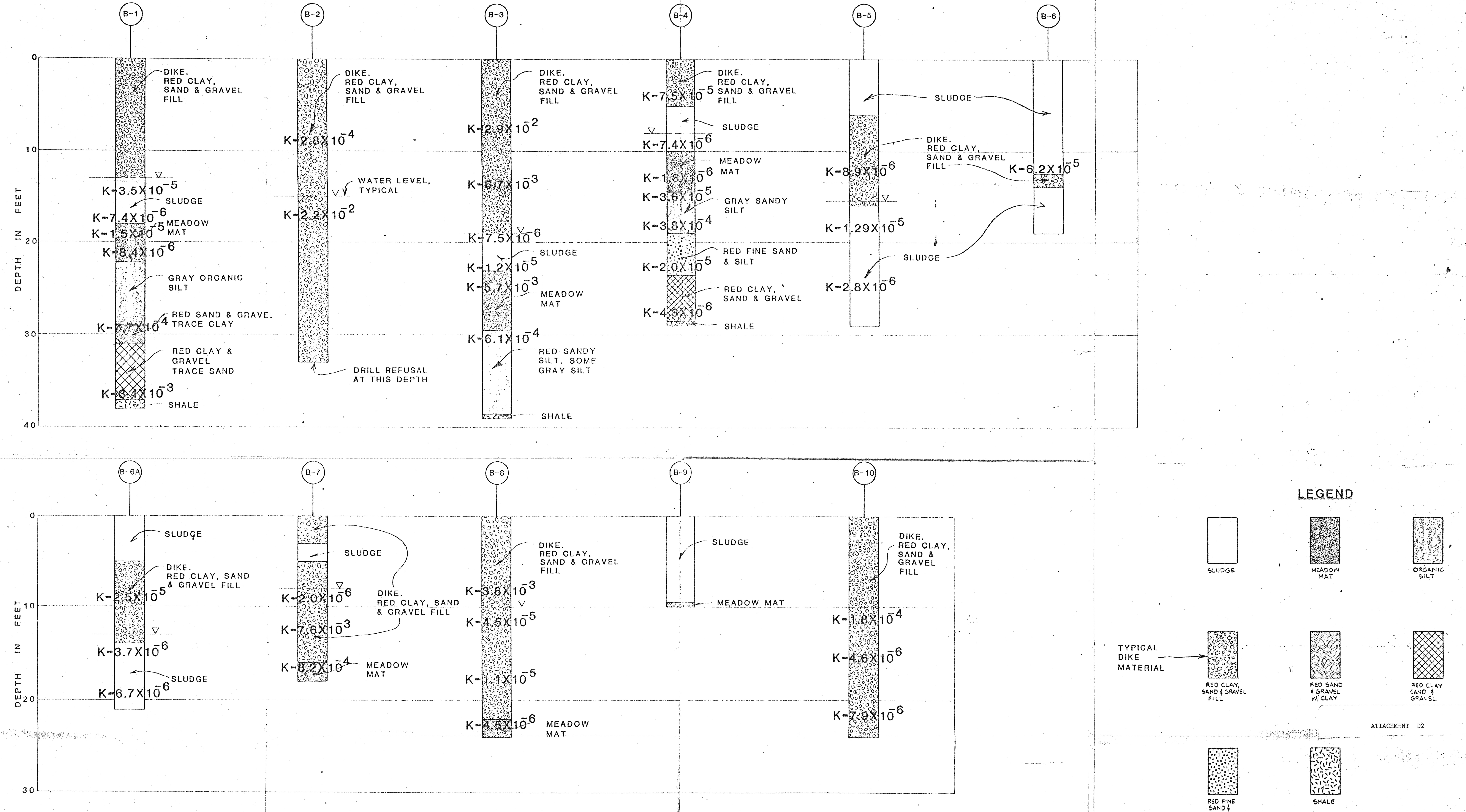
1. SAMPLES FOR JUNE & SEPTEMBER 1981 STUDIES TAKEN AT APPROXIMATELY THE SAME LOCATION.
2. PERMEABILITIES OF SAMPLES FROM JANUARY 1982 STUDY ARE SHOWN IN SHEET 2 OF 4.
3. TEST BORINGS FOR JANUARY 1982 STUDY DONE BY PHILIP J. HEALEY CO., FANWOOD, NEW JERSEY, DURING PERIOD OCTOBER 21 - NOVEMBER 5, 1981. REFER TO SHEET 2 OF 4 FOR TEST BORING LOGS.

LEGEND

- ◆ TEST BORING LOCATION - EDGE OF IMPOUND FOR JUNE & SEPTEMBER 1981 STUDIES.
- ◈ TEST BORING LOCATION - CENTER OF IMPOUND FOR JUNE & SEPTEMBER 1981 STUDIES.
- ⊕ TEST BORING LOCATION - JANUARY 1982 STUDY.
- ◪ HAND PROBINGS LOCATION - JANUARY 1982 STUDY.

REVISIONS	DESIGNED BY B.R. / DRAWN BY M.D.D. / CHECKED BY M.D.	MICHAEL DISKO, P.E. PROFESSIONAL ENGINEER N.J. LICENSE NO. 12950	M. DISKO ASSOCIATES CONSULTING ENGINEERS 2005 U.S. HIGHWAY NO. 22 P.O. BOX 1627 UNION, NEW JERSEY 07083	AMERICAN CYANAMID COMPANY WARNER'S PLANT LINDEN, NEW JERSEY	LOCATION OF TEST BORINGS & PERMEABILITY TESTS	SCALE 1"-200' / DATE JANUARY 1982 / SHEET NUMBER 1 OF 4

Michael Disko 1/8/82



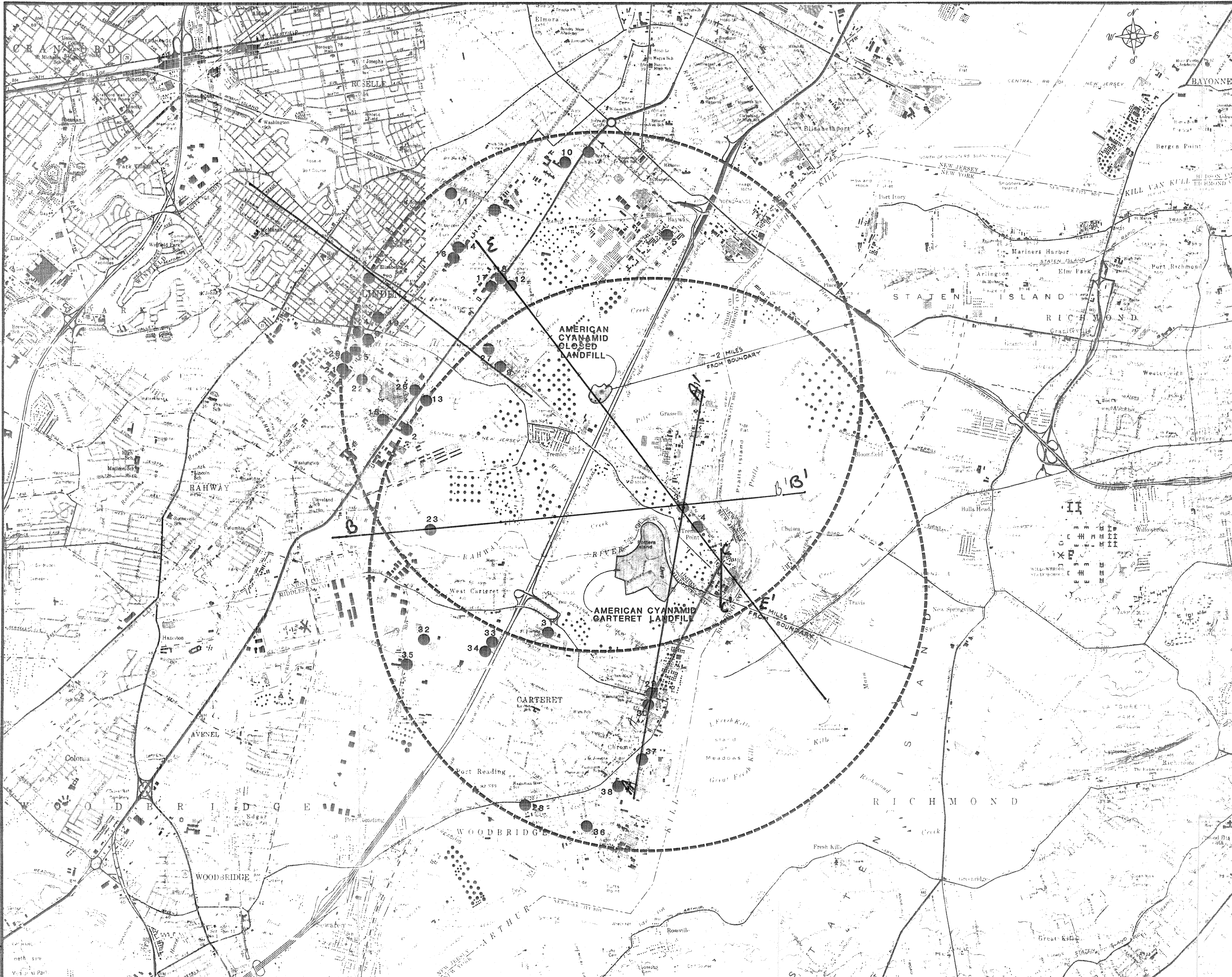
ATTACHMENT D2

NOTE:

1. BORINGS DRILLED OCTOBER 21 TO NOVEMBER 5, 1981 BY PHILIP J. HEALEY CO., FANWOOD, NEW JERSEY.
2. REFER TO SHEET 1 FOR BOREHOLE LOCATIONS.
3. TEST BORINGS ARE NOT REFERENCED TO ELEVATIONS.

REVISIONS	DESIGNED BY B.R. / DRAWN BY W.D. / CHECKED BY M.D.	MICHAEL DISKO, P.E. PROFESSIONAL ENGINEER N.J. LICENSE NO. 12950 *Michael Disko* 1/8/82	M. DISKO ASSOCIATES CONSULTING ENGINEERS 2005 U.S. HIGHWAY NO. 22 P.O. BOX 1627 UNION, NEW JERSEY 07083	AMERICAN CYANAMID COMPANY WARNER'S PLANT LINDEN, NEW JERSEY	SLUDGE IMPOUNDS TEST BORING LOGS	SCALE VERTICAL : 1"-5' / DATE JANUARY 1982 / SHEET NUMBER 2 OF 4

BRUNING 44-132 46726-3



WELL DATA

WELL NO.	OWNER	YEAR DRILLED	DEPTH (FT.)
	LINDEN		
1.	VINCENT PEZZUTO	1981	225
2.	SOLVENTS RECOVERY OF N.Y.	1981 1981	23 22.5
3.	EXXON	1980	12
4.	CITGO	1981	20
5.	STANDARD OIL STANDARD OIL	1910	383 1566
6.	UNITED LACQUER	1947	500
7.	VOLUPTE, INC.	1935	368
8.	EASTERN PACKING CO.	1950	400
9.	LINDEN MILK CO.	1922	140
10.	PARK PLASTIC CO.	1950	255
11.	MORTON SAND	1949	155
12.	ROSEHILL CEM.	1909	209
13.	PACIFIC AIRMOTIVE CORP.	1950	300
14.	PA. RR STATION	1903	122
15.	W. MELANCHUK	1952	96
16.	LINDEN CEM. ASSOC.	1912	71
17.	HOLLYWOOD DR. IN	1950	170
18.	AUTOMOTIVE PROD. CREDIT ASSN.	1957	245
19.	LINDEN ICE CO.	1959	550
20.	APEX RENDEZVOUS	1972	440
21.	LAYNE, N.Y.	1955	306
22.	SMITH KESSLER	1965	360
23.	DOG POUND	1972	460
24.	NEWARK STEEL BARREL & DRUM CO.	1930 1930 1927 1937	247 39 - 208
25.	AIRLINE FOODS	1949	266
26.	DISTILLERS CO., LTD.	1934 1934	316 306
27.	C H & JOHN WINANS	1903 1903	200 146
	CARTERET		
28.	EXXON	1981	25
29.	ROSELLE PLASTIC CORP.	1959	136
30.	VANGUARD	1969	300
31.	GULF STREAM DEV.	1967	145
32.	WILGREEN IND.	1967	300
33.	METRO GLASS	1963	200
34.	EDWARD OGAREK	1965	100
35.	KAGON & DIXON CO.	1969	440
36.	UNITED STATES METALS & REF. CO.	1954 1954	42 40
37.	AMER. AGRICULTURAL CHEMICAL CO.	1942	65
38.	CHROME STEEL CO.	1906	58

NOTE:
REFER TO REPORT FOR MORE DETAILED WELL DATA.

REVISIONS	DESIGNED BY B.R. DRAWN BY R.G.C. CHECKED BY M.D.	MICHAEL DISKO, P.E. PROFESSIONAL ENGINEER N.J. LICENSE NO. 12950 Michael Disko 1/8/82	M. DISKO ASSOCIATES CONSULTING ENGINEERS 2005 U.S. HIGHWAY NO. 22 P.O. BOX 1627 UNION, NEW JERSEY 07083	AMERICAN CYANAMID COMPANY WARNERS PLANT LINDEN , NEW JERSEY	PLAN SHOWING LOCATION OF N. J. D. E. P. REGISTERED WATER WELLS	SCALE 1"=2000FT. DATE JANUARY 1982 SHEET NUMBER 3 OF 4